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(71) Applicant:
MITSUBISHI MATERIALS CORPORATION
Chiyoda-ku, Tokyo 100 (JP)

(72) Inventor:
Takeda, Yoshinobu,
c/o Mitsubishi Materials Corp.
Niigata-shi, Niigata-ken (JP)

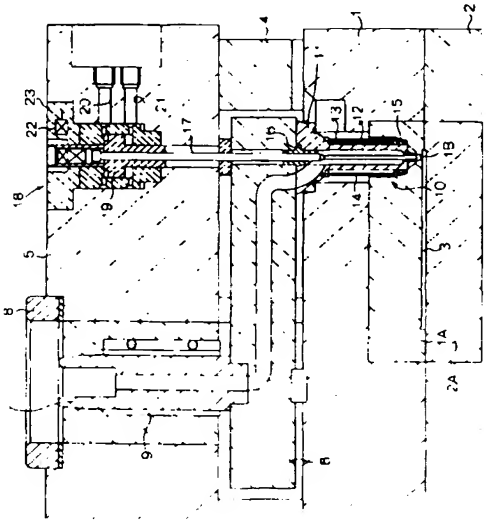
(74) Representative:
Füchsle, Klaus, Dipl.-Ing. et al
Hoffmann Eitle,
Patent- und Rechtsanwälte,
Arabellastrasse 4
81925 München (DE)

(54) Valve gate device and injection mold provided with the same

(57) [Purpose] To provide a valve gate device and an injection mold provided with the valve gate device, wherein a movable pin moves easily in order to properly open and close the gate, thereby preventing damage to the valve gate device and the mold.

[Solving means] A movable pin 17 is made more durable by using a harder material for the movable pin 17 than for a valve body 11, and a slight distance can be maintained between the movable pin 17 and the valve body 11 by making the thermal expansion coefficient of the movable pin 17 smaller than that of the valve body 11, so that the problem of initial improper movement of the movable pin 17 can be eliminated.

FIG. 1



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Description

[Detailed Description of the Invention]

[Industrial Field of the Invention]

[0001] The present invention relates to a valve gate device with a movable pin (valve pin) for opening and closing a gate, in an injection mold having a cavity between a pair of mold plates in order to supply resin into the cavity through the gate, and an injection mold provided with the valve gate device.

[Description of the Related Art]

[0002] In a known conventional injection mold of this type, a cavity is formed between a stationary mold plate and a movable mold plate, and a valve body with a resin-conveying path which communicates with the aforementioned cavity through a gate is provided within the stationary mold plate. In addition, a movable pin is provided so as to be movable in an axial direction thereof in the resin-conveying path of the valve body, with one end of the movable pin being used for opening and closing the gate.

[Problems to be Solved by the Invention]

[0003] However, the above-described conventional injection mold has the problem that the movable pin does not properly open and close the gate since it cannot not move easily, when the mold is becoming hot at the start of injection molding.

[0004] The present inventor et al., having studied the problem, found out that the movable pin does not move easily because the movable pin and the mold plates forming the valve body and the gate are made of the same material (such as die steel), so that they have the same thermal expansion coefficient, and because there is resin resistance at the start of injection molding.

[0005] In addition, there are other problems. Application of resin pressure for injecting resin into the cavity, with the gate kept closed by the movable pin not capable of moving easily, may cause the valve gate device to break. Further, opening the mold, with the gate kept opened as a result of failure of the movable pin to close the gate, causes the resin that has leaked out to cool and solidify. The cooled and solidified resin may cause the mold to break during the next molding process.

[0006] In view of the above-described problems, it is an object of the present invention to provide a valve gate device, and an injection mold provided with the valve gate device, wherein the movable pin moves easily in order to properly open and close the gate, thereby preventing damage to the valve gate device and the mold.

[Means for Solving the Problems]

[0007] According to Claim 1 of the present invention, there is provided a valve gate device for use in an injection mold having a cavity formed between a pair of mold plates in order to supply resin into the cavity through a gate, the valve gate device comprising a valve body having a resin-conveying path which communicates with the cavity through the gate; and a movable pin for opening and closing the gate, which is disposed within the valve body so as to be movable along an axial line of the movable pin; wherein the movable pin is formed of high-speed tool steel SKH-51 and has a hardness H_{RC} of 60 to 62, and the valve body is formed of hot die steel SKD-6 and has a hardness H_{RC} of 46 to 50.

[0008] According to Claim 1, the movable pin is made more durable by using a harder material for the movable pin than for the valve body, and a slight distance can be maintained between the movable pin and the valve body by making the thermal expansion coefficient of the movable pin smaller than that of the valve body. Therefore, the problem of initial improper movement of the movable pin can be eliminated.

[0009] In Claim 2, the movable pin has a titanium coating applied thereto.

[0010] According to Claim 2, the wear resistance and the lubricity of the movable pin can be increased by applying a titanium coating to the movable pin, thereby making it harder for the resin to stick onto the movable pin as a result of increased wettability of the resin.

[0011] According to Claim 3, there is provided an injection mold having a cavity between a pair of mold plates in order to supply resin into the cavity through a gate, wherein a valve gate device of Claims 1 or 2 is provided at one of the mold plates, and wherein the cavity forming the gate is formed of hardened steel and has a hardness H_{RC} of 52 to 55.

[0012] According to Claim 3, the movable pin can be made more durable by using a harder material for the movable pin than for the cavity forming the gate. In addition, a slight distance can be maintained between the movable pin and the valve body by making the thermal expansion coefficient of the movable pin smaller than that of the cavity forming the gate. Therefore, the problem of initial improper movement of the movable pin can be eliminated.

[0013] According to Claim 4, there is provided a valve gate device for use in an injection mold having a cavity formed between a pair of mold plates in order to supply resin into the cavity through a gate, the valve gate device comprising a valve body having a resin-conveying path which communicates with the cavity through the gate; and a movable pin for opening and closing the gate, which is disposed within the valve body so as to be movable along an axial line of the movable pin; and detecting means for detecting the position of the movable pin.

[0014] According to Claim 4, when the position of the

movable pin is monitored by the detecting means, and the detecting means judges that the movable pin is not at the proper position, the molding process is stopped.

[Brief Description of the Drawings]

[Fig. 1]

[0015] Fig. 1 is a sectional view of the main portion of an injection mold.

[Description of the Embodiment]

[0016] A description will now be given of an embodiment of the present invention with reference to Fig. 1.

[0017] Fig. 1 is a view showing a hot runner mold, in which reference numeral 1 denotes a stationary mold plate. A movable mold plate 2 is provided so that it can move towards or away from the stationary mold plate 1. Inserts 1A and 2A are provided at the mold plates 1 and 2, respectively. A cavity 3, having the shape of the molded product, is formed between the inserts 1A and 2A. A stationary mounting plate 5 is mounted to the stationary mold plate 1 through a spacer block 4, with a manifold 6 disposed between the stationary mold plate 1 and the stationary mounting plate 5. A sprue bush 7 and a locate ring 8 are provided at the stationary mounting plate 5, with a heater 9 provided at the outer periphery of the sprue bush 7. A valve body 11 of a valve gate device 10 is provided within the stationary mold plate 1 and the insert 1A. A temperature sensor 12 and a heater 13 are provided at the outer periphery of one end of the valve body 11. A heater cover 14 is provided at the outer periphery of the heater 13, and a seal ring 15 is provided at one end of the valve body 11. Molten resin is supplied to the cavity 3 by allowing it to pass through the sprue bush 7, the manifold 6, the valve body 11, and pass by the insert 1A.

[0018] A closing member 16 is internally provided in the upper portion of the valve body 11. A movable pin 17, being supported and guided by the inner portion of the closing member 16 and the inner portion of one end of the valve body 11, is capable of sliding along the axial line thereof. The manifold 6 and the stationary mounting plate 5 are inserted into the base end side of the movable pin 17. The base end portion of the movable pin 17 is mounted to a piston 19 of a fluid pressure cylinder 18 provided within the stationary mounting plate 5. A fluid is supplied to the fluid pressure cylinder 18 through two fluid-supplying paths 20 and 21 that are formed in the stationary mounting plate 5, whereby the piston 19 is moved along with the movable pin 17. A proximity switch (detecting means) 22, opposing the base end portion of

[0019] The movable pin 17 is made of high-speed tool steel SKH-51 and has a hardness H_{RC} of 60 to 62. A titanium coating (titanium nitride (TiN) coating) is applied to the surface of the movable pin 17 by the CVD method. Therefore, resin does not easily stick onto the surface of the movable pin 17, allowing the movable pin 17 to move easily. In addition, the movable pin 17 has a smaller thermal expansion coefficient than the portions (valve body 11 and the insert 1A) that slidably contact the movable pin 17. Therefore, the movable pin 17 can made to move easily at the start of molding, and has excellent wear resistance and lubricity, so that even when the movable pin 17 is used for a long time, the movable pin 17 does not get damaged, thereby making it much more durable.

[0020] If by any chance the movable pin 17 cannot not move easily as a result of, for example, mixing of an impurity in the resin or a bad molding environment, the movement of the base end portion of the movable pin 17 (or the piston 19) can be detected by means of the proximity switch 22 that causes production of a signal for detecting any abnormal opening or closing of the gate 1B in order to quickly stop the molding machine. In other words, the movement of the movable pin 17 is judged as abnormal, when the base end portion of the movable pin 17 continues to be detected by means of the proximity switch 22, even though the gate close command signal has been generated for a predetermined time, or when the base end portion of the movable pin 17 is not detected by means of the proximity switch 22, even though the gate open command signal has been generated for a predetermined time. As a result, damage to the valve gate device or the mold can be prevented beforehand.

[Advantages]

[0021] As can be understood from the foregoing description, according to Claim 1 of the present invention, the movable pin can be made much more durable by using a harder material for the movable pin than for the valve body. In addition, a slight distance can be maintained between the movable pin and the valve body by making the thermal expansion coefficient of the movable pin smaller than that of the valve body. Therefore, the problem of initial improper movement of the movable pin can be eliminated.

[0022] According to Claim 2, the wear resistance and the lubricity of the movable pin can be increased by applying a titanium coating to the movable pin, thereby making it harder for resin to stick onto the movable pin as a result of increased wettability of the resin. Therefore, easy movement of the movable pin can be ensured.

[0023] According to Claim 3 of the present invention,

body by making the thermal expansion coefficient of the movable pin smaller than that of the mold plate forming

the gate. Therefore, the problem of initial improper movement of the movable pin can be eliminated.

[0024] According to Claim 4 of the present invention, when the position of the movable pin is monitored by the detecting means, and a judgment is made that the movable pin is not at the proper position, the molding process can be quickly and reliably stopped. Therefore, damage to the valve gate device and mode can be prevented beforehand.

[Reference Numerals]

[0025]

1 ... Stationary mold plate
1A, 2A ... Inserts
1B ... Gate
2 ... Movable mold plate
3 ... Cavity
10 ... Valve gate device
11 ... Valve body
17 ... Movable pin
22 ... Proximity switch (detecting means)

Claims

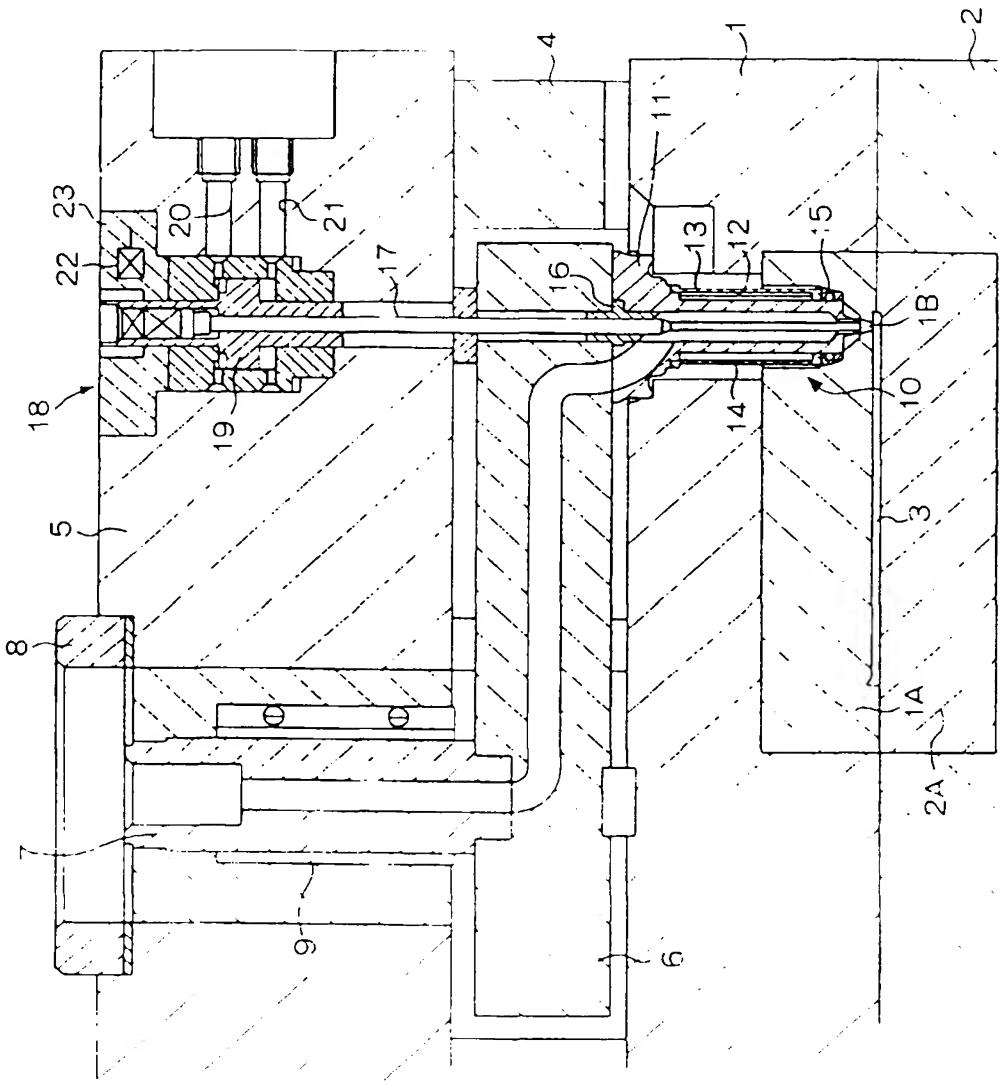
1. A valve gate device for use in an injection mold having a cavity formed between a pair of mold plates in order to supply resin into the cavity through a gate, said valve gate device comprising a valve body having a resin-conveying path which communicates with the cavity through the gate; and a movable pin for opening and closing the gate, which is disposed within said valve body so as to be movable along an axial line of said movable pin; wherein said movable pin is formed of high-speed tool steel SKN-51 and has a hardness H_{RC} of 60 to 62, and said valve body is formed of hot die steel SKD-6 and has a hardness H_{RC} of 46 to 50.

2. A valve gate device according to Claim 1, wherein said movable pin has a titanium coating applied thereto.

3. An injection mold having a cavity between a pair of mold plates in order to supply resin into said cavity through a gate, wherein a valve gate device of Claims 1 or 2 is provided at one of said mold plates, and wherein said cavity forming said gate is formed of hardened steel and has a hardness H_{RC} of 52 to 55

4. A valve gate device for use in an injection mold having a cavity formed between a pair of mold plates in order to supply resin into the cavity through a gate, said valve gate device comprising a valve body having a resin-conveying path which communicates with the cavity through the gate; a movable pin for opening and closing the gate, which is disposed within said valve body so as to be movable along an axial line of said movable pin; and detecting means for detecting the position of said movable pin.

FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 98 10 5112

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	EP 0 069 998 A (GELLERT JOBST U) 19 January 1983 * page 6, line 1 - line 6; figure 6 *	1	B29C45/28
T	PATENT ABSTRACTS OF JAPAN vol. 98, no. 14, 31 December 1998 & JP 10 235683 A (FUJI SEIKI KK), 8 September 1998 * abstract *	2	
X	PATENT ABSTRACTS OF JAPAN vol. 16, no. 359 (M-1289), 4 August 1992 -& JP 04 112020 A (MITSUBISHI MATERIALS CORP), 14 April 1992 * abstract *	4	
X	DE 38 33 220 A (AGFA-GEVAERT AG) 5 April 1990 * column 4, line 27 - line 45; figure 2 *	4	
X	US 5 055 026 A (GORDON EDWARD A) 8 October 1991 * the whole document *	4	TECHNICAL FIELDS SEARCHED (Int.Cl.6) B29C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	18 May 1999	Bollen, J

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

FIG. 1